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(54) HYBRID WIND POWER TOWER BASED ON EDGE-STIFFENED COMBINED SHELLS

(57) The present application discloses a hybrid wind power tower based on edge-stiffened combined shells, and relates to the technical field of wind power generation. An upper part of the system is a pure steel tower, while a lower part thereof is a combined tower. The combined tower is formed by assembling 2 to 8 edge-stiffened combined shells in a circumferential direction, and is assembled in segments in a vertical direction. Each of the edge-stiffened combined shells consists of a hollow concrete-filled steel tube structure, and external plates, internal plates and stiffening plates arranged around the hollow concrete-filled steel tube structure. The hollow concrete-filled steel tube structure consists of an outer steel tube, an inner steel tube and concrete. Studs, angle steel, T-shaped steel, or a combination thereof are welded on a side of the steel tube in advance, and the concrete is then poured. The system gives full play to the advantages of the combined structure, and is reasonable in stress form and reliable in connection. All members can be prefabricated in advance and assembled on site. The system is high in construction efficiency, low in material consumption and convenient to transport, and has a promising prospect in engineering applications.

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Description

TECHNICAL FIELD

[0001] The present application relates to the technical field of wind power generation.

BACKGROUND

[0002] Wind power energy is pollution-free and renewable clean energy. Wind power farms have been widely used in recent years due to high power production, stable fan operation and mature manufacturing technology.

[0003] With the increasing demand for wind power energy, high-power and high-tower wind turbines become popular. Conventional wind turbines mostly use pure steel towers. In order to meet the requirements for stability, strength and fatigue, the towers are generally large in diameter and wall thickness, resulting in material waste, difficult construction and inconvenient transportation. Therefore, it is necessary to develop a novel combined tower that is safe, reliable, convenient for construction and transportation, and low in cost.

SUMMARY

[0004] The present application provides a hybrid wind power tower based on edge-stiffened combined shells. An upper part of the system is a pure steel tower, while a lower part thereof is a combined tower. The combined tower is formed by assembling 2 to 8 edge-stiffened combined shells in a circumferential direction, and is assembled in segments in a vertical direction. Each of the edge-stiffened combined shells consists of a hollow concrete-filled steel tube structure, and external plates, internal plates and stiffening plates arranged around the hollow concrete-filled steel tube structure. The system gives full play to the advantages of the combined structure, and is reasonable in stress form and reliable in connection. All members can be prefabricated in advance and assembled on site. The system is high in construction efficiency, low in material consumption and convenient to transport and has a promising prospect in engineering applications.

[0005] The technical solution of the present application will be described below.

[0006] A hybrid wind power tower based on edge-stiffened combined shells is provided, which relates to the technical field of wind power generation, wherein the system includes a pure steel tower, a combined tower, edge-stiffened combined shells, a hollow concrete-filled steel tube structure, outer steel tubes, inner steel tubes, concrete, external plates, internal plates, stiffening plates, bolts, flange plates, studs, angle steel and T-shaped steel. An upper part of the system is the pure steel tower while a lower part thereof is the combined tower, and the pure steel tower and the combined tower are connected by the flange plates and the bolts. The combined tower is formed by assembling a plurality of edge-stiffened combined shells.

[0007] The combined tower is formed by assembling 2 to 8 edge-stiffened combined shells in a circumferential direction, and is assembled in segments in a vertical direction. The edge-stiffened combined shells are prefabricated in a factory and each consist of a hollow concrete-filled steel tube structure, and external plates, internal plates and stiffening plates arranged around the hollow concrete-filled steel tube structure. Adjacent edge-stiffened combined shells are connected by the bolts.

[0008] The hollow concrete-filled steel tube structure consists of an outer steel tube, an inner steel tube and concrete, with both the cross section of the outer steel tube and the cross section of the inner steel tube gradually decreasing from the bottom up. On an inner side of the outer steel tube and an outer side of the inner steel tube, the studs, the angle steel, the T-shaped steel or a combination thereof are welded in advance at certain intervals, and the concrete is then poured. The concrete may be ordinary concrete or lightweight aggregate concrete.

[0009] The internal plates are welded on upper, lower, left and right sides of the hollow concrete-filled steel tube structure, the periphery of the outer steel tube is extended outward by a certain distance and then welded with the external plates, and bolt holes are reserved on the external plates. A certain number of stiffening plates are uniformly arranged between the external plates and the internal plates to form a peripheral edge-stiffened region.

[0010] Compared with the prior art, the present application has the following beneficial effects.

(1) All members can be prefabricated in a factory and directly assembled on site, so it is convenient for construction and the production efficiency is high.
(2) The tower is assembled in blocks and in segments, so it is convenient for transportation and stacking on site.
(3) By using the hollow concrete-filled steel tube structure, the tower has the following obvious advantages when compared with the conventional pure steel towers: high stiffness in the cross section, high stability and low material consumption. Moreover, the use of the lightweight aggregate concrete results in light weight, so the cost for transportation and hoisting of prefabricated members can be saved.
(4) In an innovative connection way, the tower is reasonable in force transfer, reliable in connection, simple in construction and convenient for large-scale application and popularization.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

Fig. 1 is an overall schematic view of the present application;

Fig. 2 is a schematic sectional view of the body of the combined tower according to the present application;

Fig. 3 is a schematic view of the edge-stiffened combined shell according to the present application, including three-dimensional overall view and detailed view of the interior;

Fig. 4 is a schematic view of the hollow concrete-filled steel tube structure, for the purpose of instability prevention, according to the present application; and

Fig. 5 is a schematic view of the connection between the pure steel tower and the combined tower according to the present application;

in which:

1: pure steel tower; 2: combined tower; 3: edge-stiffened combined shell; 4: hollow concrete-filled steel tube structure; 5: outer steel tube; 6: inner steel tube; 7: concrete; 8: external plate; 9: internal plate; 10: stiffening plate; 11: bolt; 12: flange plate; 13: stud; 14: angle steel; and 15: T-shaped steel.

DETAILED DESCRIPTION

[0012] The present application will be further described below with reference to the accompanying drawings.

[0013] As shown in Fig. 1, a hybrid wind power tower based on edge-stiffened combined shells is provided. An upper part of the system is a pure steel tower 1, while a lower part thereof is a combined tower 2. The combined tower 2 is formed by assembling a plurality of edge-stiffened combined shells 3.

[0014] As shown in Fig. 2, the combined tower 2 is formed by assembling 2 to 8 (4, in this figure as an example) edge-stiffened combined shells 3 in a circumferential direction, and is assembled in segments in a vertical direction. The edge-stiffened combined shells 3 are prefabricated in a factory and each consist of a hollow concrete-filled steel tube structure 4, and external plates 8, internal plates 9 and stiffening plates 10 arranged around the hollow concrete-filled steel tube structure 4. Adjacent edge-stiffened combined shells 3 are connected by the bolts 11.

[0015] As shown in Fig. 3, the internal plates 9 are welded on upper, lower, left and right sides of the hollow concrete-filled steel tube structure 4. The periphery of the outer steel tube 5 is extended outward by a certain distance and then welded with the external plates 8, and bolt holes are reserved on the external plates 8. A certain number of stiffening plates 10 are uniformly arranged between the external plates 8 and the internal plates 9 to form a peripheral edge-stiffened region.

[0016] As shown in Fig. 4, the hollow concrete-filled steel tube structure 4 consists of an outer steel tube 5, an inner steel tube 6 and concrete 7, with both the cross section of the outer steel tube 5 and the cross section of the inner steel tube 6 gradually decreasing from the bottom up. On an inner side of the outer steel tube 5 and an outer side of the inner steel tube 6, the studs 13, the angle steel 14, the T-shaped steel 15 or a combination thereof are welded in advance at certain intervals, and the concrete 7 is then poured. The concrete 7 can be ordinary concrete or lightweight aggregate concrete.

[0017] As shown in Fig. 5, the pure steel tower 1 in the upper part and the combined tower 2 in the lower part are connected by the flange plates 12 and the bolts 11.

[0018] The present application provides a hybrid wind power tower based on edge-stiffened combined shells. The system gives full play to the advantages of the combined structure, and is reasonable in stress form and reliable in connection. All members can be prefabricated in advance and assembled on site. The system is high in construction efficiency, low in material consumption and convenient to transport, and has a promising prospect in engineering applications.

[0019] The foregoing description merely shows the preferred implementations of the present application, and the present application is not limited to the specific implementations described above. A person of ordinary skill in the art can make various modifications or supplements to the implementations or replace the implementations in a similar way without departing from the principle of the present application, and these modifications, supplements or replacements shall fall into the protection scope of the present application.

[0020] Although the terms (such as, 1: pure steel tower; 2: combined tower; 3: edge-stiffened combined shell; 4: hollow concrete-filled steel tube structure; 5: outer steel tube; 6: inner steel tube; 7: concrete; 8: external plate; 9: internal plate; 10: stiffening plate; 11: bolt; 12: flange plate; 13: stud; 14: angle steel; and, 15: T-shaped steel) have been frequently used herein, other terms are also possible. These terms are merely used for more conveniently describing and explaining the essence of the present application, and the interpretation of these terms into any additional limitations shall be departed from the spirit of the present application.

Claims

1. A hybrid wind power tower based on edge-stiffened combined shells, which relates to the technical field of wind power generation, wherein the system comprises a pure steel tower (1), a combined tower (2), edge-stiffened combined shells (3), a hollow concrete-filled steel tube structure (4), outer steel tubes (5), inner steel tubes (6), concrete (7), external plates (8), internal plates (9), stiffening plates (10), bolts (11), flange plates (12), studs (13), angle steel (14) and T-shaped steel (15); an upper part of the system is the pure steel tower (1) while a lower part thereof is the combined tower (2), and the pure steel tower (1) and the combined tower (2) are connected by the flange plates (12) and the bolts (11); and, the combined tower (2) is formed by assembling a plurality of edge-stiffened combined shells (3).

2. The hybrid wind power tower based on edge-stiffened combined shells according to claim 1, wherein the combined tower (2) is formed by assembling 2 to 8 edge-stiffened combined shells (3) in a circumferential direction, and is assembled in segments in a vertical direction; the edge-stiffened combined shells (3) are prefabricated in a factory and each consist of a hollow concrete-filled steel tube structure (4), and external plates (8), internal plates (9) and stiffening plates (10) arranged around the hollow concrete-filled steel tube structure (4); and, adjacent edge-stiffened combined shells (3) are connected by the bolts (11).

3. The hybrid wind power tower based on edge-stiffened combined shells according to claim 1, wherein the hollow concrete-filled steel tube structure (4) consists of an outer steel tube (5), an inner steel tube (6) and concrete (7), wherein both the cross section of the outer steel tube (5) and the cross section of the inner steel tube (6) gradually decrease from the bottom up; on an inner side of the outer steel tube (5) and on an outer side of the inner steel tube (6), the studs (13), the angle steel (14), the T-shaped steel (15) or a combination thereof are welded in advance at certain intervals, and the concrete (7) is then poured; and, the concrete (7) can be ordinary concrete or lightweight aggregate concrete.

4. The hybrid wind power tower based on edge-stiffened combined shells according to claim 1, wherein the internal plates (9) are welded on upper, lower, left and right sides of the hollow concrete-filled steel tube structure (4); the periphery of the outer steel tube (5) is extended outward by a certain distance and then welded with the external plates (8), and bolt holes are reserved on the external plates (8); and, a certain number of stiffening plates (10) are uniformly arranged between the external plates (8) and the internal plates (9) to form a peripheral edge-stiffened region.

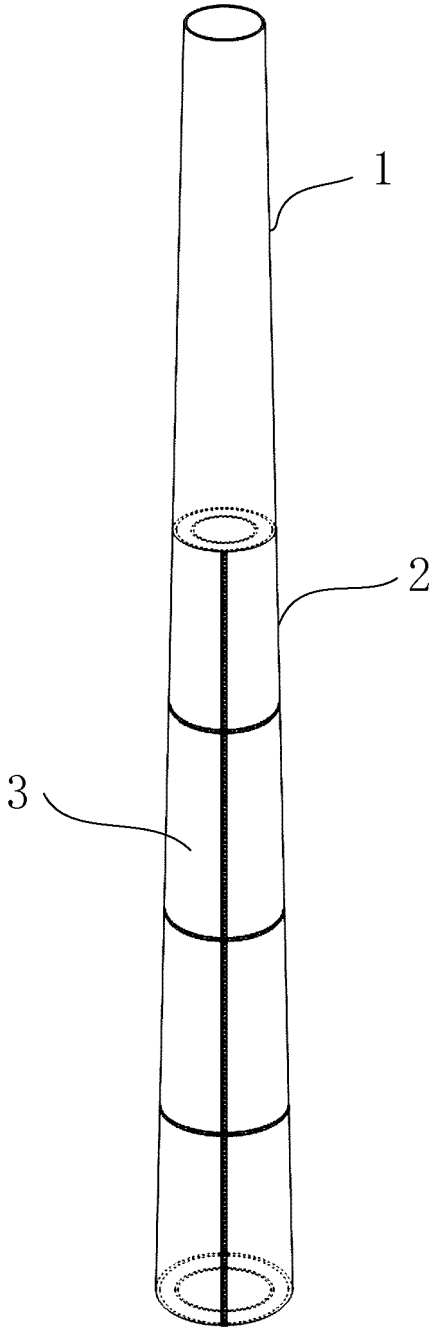

FIG. 1

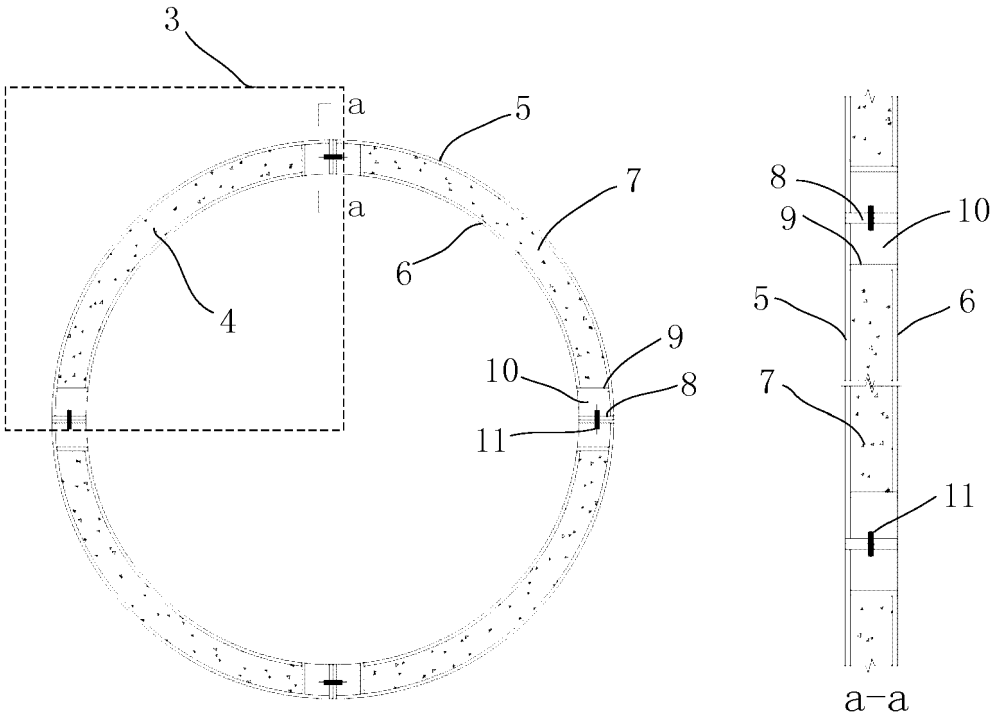

FIG. 2

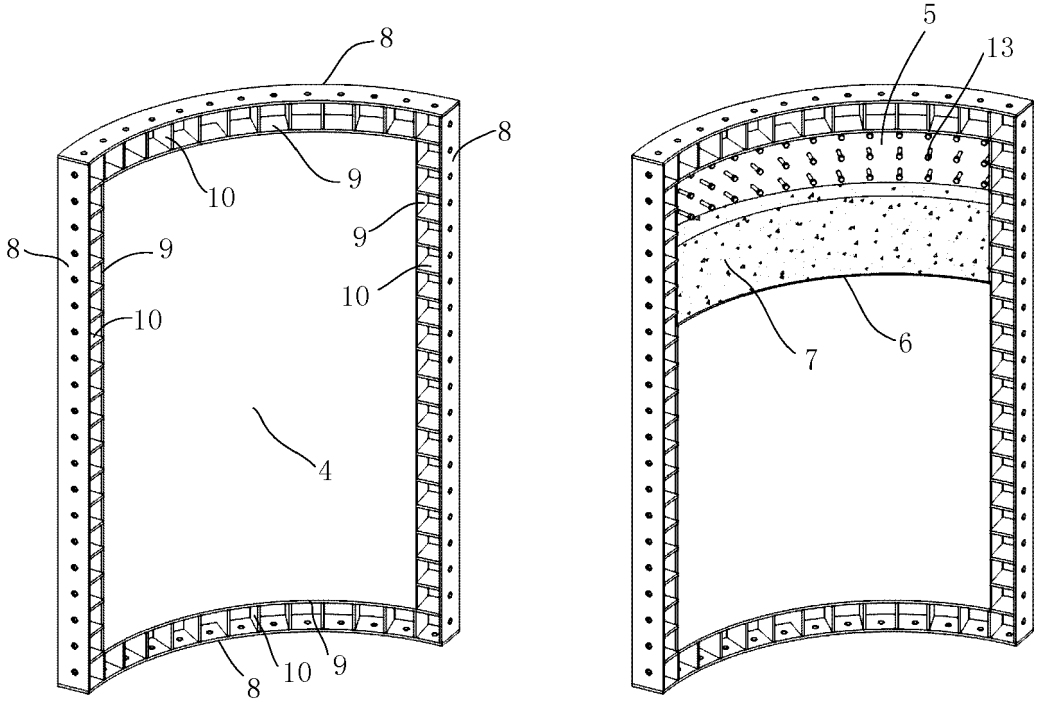

FIG. 3

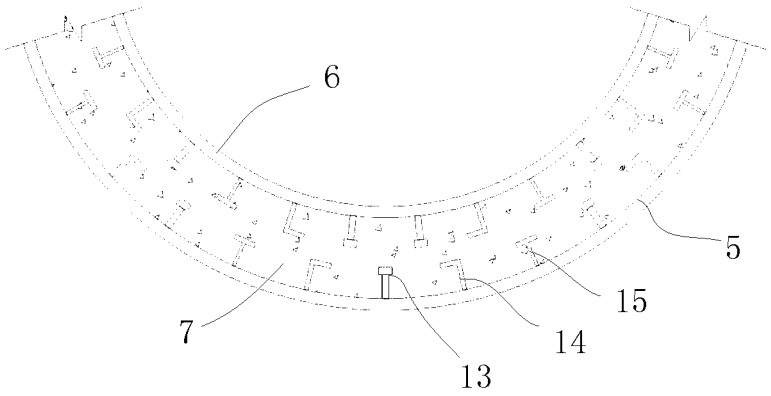

FIG. 4

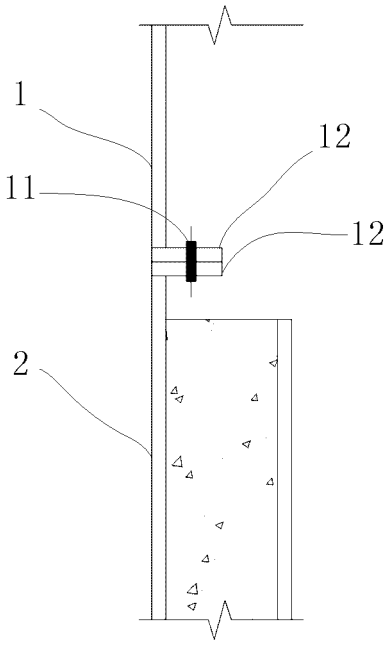

FIG. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 19 21 4321

DOCUMENTS CONSIDERED TO BE RELEVANT

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A	* paragraph [0035]; claim 1; figures 1-7 *	2	
Y	EP 1 606 514 A1 (VESTAS WIND SYSTEM AS [DK]) 21 December 2005 (2005-12-21) * claim 1; figures 1-5 *	1,3,4	
X,P	CN 209 398 541 U (UNIV CHONGQING) 17 September 2019 (2019-09-17) * claims 1-4; figures 1-5 *	1-4	

TECHNICAL FIELDS SEARCHED (IPC)
F03D
E04H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	22 April 2020	Król, Marcin

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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22-04-2020

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82